Technological parameters for EEW MNPs processing: C - capacitance of the capacitor bank; Uo – voltage corresponding to the charged capacitor bank just prior to explosion; l – the wire length; K - overheating or the ratio of the energy injected into the wire to the sublimation energy of the wire metal, W_s – sublimation energy for the wire of the lengths l and $W_0 = CU_0^2/2$ and M_s – is a saturation magnetization at 300 K.

Sample	U_0, kV	C, mcF	l, mm	K = W_0/Ws	S_{sp}, m^2/g	γ-phase		
						%	D_{csr}, nm	M_s, emu/g)
FeNi -1	30	3.2	70	2.3	13.5	90	34	140
FeNi -2	30	1.6	70	1.9	12.1	90	36	130
FeNi -3	20	1.6	70	1.2	7.8	93	60	70
FeNi -4	20	1.6	100	0.8	4.6	95	83	40

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Selected measurements were performed at SGIker services of UPV-EHU. This work was supported by the Russian Federation state assignment # 0389-2014-0002 and Spanish MECMAT 2014-55049-C2-1-R grant.

THE EFFECT OF DIFFERENT AC CURRENT DENSITY ON THE MAGNETOIMPEDANCE OF CoFeMoSiB AMORPHOUS RIBBONS IN THE PRESENCE OF IRON OXIDE NANOPARTICLES WATER BASED FERROFLUID

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Biocompatible magnetic nanoparticles (MNPs) are widely proposed for different biomedical applications. For the majority of them they must be prepared as water-based ferrofluids. Magnetic biosensing is a promising research and applications direction. The first giant magnetoimpedance biosensor prototype based on amorphous rapidly quenched ribbon was proposed, discussed and successfully demonstrated long ago [1]. In GMI biosensors related to magnetic label detection the change in the total impedance of the sensitive element under application of an external magnetic field depends on the concentration of magnetic particles. The GMI response features are controlled by the number of parameters and the alternating current plays an important role as the alternating current (AC) current flowing through the sample creates a circumferential magnetic field and can produce a sizeable Joule heating.

In this work, the GMI response of CoFeMoSiB amorphous ribbon was measured in the presence of magnetite ferrofluid and without it at different AC driving current frequencies (f) and current intensities. For GMI measurements in presence of water-based ferrofluid with MNPs of the iron oxide we selected 3.5 cm long CoFeMoSiB amorphous ribbon with the thicknesses of 20 microns and widths of about 0.7 mm. GMI sensitive element was placed into a plastic tube (30 mm length and 1 mm in diameter). Amorphous ribbon element was located in center of a tube filled with ferrofluid. Different frequency (0.5-10 MHz) of the driving AC current (I_{pp}=1-20 mA, where I_{pp} is a peak-to-peak intensity) amplitudes were tested in the maximum external magnetic fields $H_{max}= \pm$ 200 Oe. GMI ratio for total impedance was defined as follows: $\Delta Z/Z= 100\times(Z(H) - Z_{max})/Z_{max}$. For different AC current densities the maximum value of $\Delta Z/Z$ ratio increased up to the f=5 MHz showing no change for the higher frequencies. The discussion of the careful selection of the current intensity is missed in the literature but it is very important since non-linear excitation is characteristic for high current intensities (for ribbons above 5 mA). For all AC current densities the $\Delta Z/Z$ (f) response of the ribbon itself was higher in comparison of the response of the ribbon immersed into ferrofluid. The maximum GMI values do not depend on the driving current intensity in the range under consideration. The GMI sensing process counts with three magnetic fields: the AC magnetic field of the AC current passing through the ribbon, the DC external magnetic field produced and the stray fields created by superparamagnetic MNPs in the external DC magnetic filed. The presence of stray magnetic field of the particles changes the superposition of the constant applied field and the alternating field, and thus alters the $\Delta Z/Z$ ratio.

1. Kurlyandskaya G.V., Sanchez M.L., Hernando B. et al. // Applied Physics Letters. 2003. V. 82, I. 18. P. 3053–3055.

Selected measurements were performed at SGIker services of UPV-EHU. This work was supported by Spanish ACTIMAT grant. We thank A.P. Safronov, I.V. Beketov and Yu. P. Novoselova for special support.